

## ROOF BOUNDARY CLIP

## BACKGROUND OF THE INVENTION

The present invention relates to the connection of roof diaphragms to the  
5 vertical walls of a structure. The roof diaphragm must remain connected to the  
walls in order to maintain the integrity of the entire structure. The connections  
between the roof diaphragm and the walls must principally resist two forces:  
uplift, particularly in high wind areas, where hurricanes or tornadoes can lift the  
roof off a structure; and sheer, particularly in earthquake-prone areas. The  
10 connection of the present invention is designed to resist shear forces. Roof  
trusses or rafters that support and form part of the roof diaphragm, rest on the  
tops of the walls of a structure. The ends of the trusses or rafters are typically  
tied down with hurricane ties or the like in order to resist uplift. To resist shear  
forces, blocking members are placed between the ends of the trusses or rafters,  
15 parallel to and on top of the walls, strengthening and forming part of the roof  
diaphragm. The ends of the trusses or rafters are toenailed - the driving of  
elongated fasteners such as nails at an angle through one member and into the  
other -- into the blocking members. The sheathing -- typically plywood or  
oriented strand board -- can also be nailed to the blocking creating an even  
20 stronger roof diaphragm. The clip of the present invention is a new and superior  
means of attaching the blocking members to the walls in order to resist shear  
forces that would otherwise tend to push the roof off the tops of the walls. .

Clips are presently used to attach the blocking of roof diaphragms to the  
top portions of walls to provide shear anchorage for roof diaphragms; however,  
25 there exists a need in the industry for making a more reliable connection  
between the roof diaphragm and the top of the wall that is easily accomplished  
and amenable to current building practices.

## BRIEF SUMMARY OF THE INVENTION

The gist of the present invention is to provide a clip that eases installation of the clip to blocking members both in the field and at the factory by the truss manufacturer.

- 5 It is an object of the present invention to provide a roof boundary connection having a wall having a top portion, the top portion having a top surface and an outer surface, a plurality of generally horizontal structural members surmounting and disposed generally perpendicular to the wall, a first blocking member having a bottom side, an inner side, outer side, a first end and a second end, each of
- 10 said first and second ends in substantially abutting relationship with one of said plurality of generally horizontal members, a first clip connecting the first blocking member to the top portion of the wall, the clip having a body, having an attachment side and an opposing side, said body being divided into a base portion and a tab attachment portion joined to the base portion, and a first
- 15 indexing tab projecting from the attachment side, wherein the first indexing tab interfaces with one of the top portion of the wall and the first blocking member, and a first plurality of fasteners attaches the clip to the top portion of the wall and a second plurality of fasteners attaches the clip to the first blocking member.
- 20 It is further object of the present invention to provide a method of making a roof boundary connection between the top portion of a wall and a blocking member disposed between and attached to a pair of generally horizontal structural members surmounting and disposed generally perpendicular to the wall, by means of a clip connecting the first blocking member to the top portion of the
- 25 wall, the clip having a body, having an attachment side and an opposing side, said body being divided into a base portion and a tab attachment portion joined to the base portion, and a first indexing tab projecting from the attachment side, wherein the first indexing tab interfaces with one of the top portion of the wall and the first blocking member, and by means of a first plurality of fasteners that
- 30 attaches the clip to the top portion of the wall, and by means of a second plurality of fasteners that attaches the clip to the first blocking member,

wherein a portion of the clip is placed against the blocking member and the second plurality of fasteners is driven into the first blocking member, and a portion of the clip is placed against the top portion of the wall and the first plurality of fasteners is driven into the top portion of the wall, and

- 5 the clip is bent along between the base portion and the tab attachment portion, and the blocking is attached to the pair of generally horizontal structural members at either end of the blocking.

- It is an additional object of the present invention to employ nail prongs as
- 10 integral connectors for attachment to blocking members, allowing truss manufacturers to pre-install connectors on blocking members at their factory with the same hydraulic presses that are used to assemble trusses with nail prong plates. The truss supplier will know the spacing needed for the trusses in the roof and can therefore cut the blocking members correctly in advance of
- 15 installation, and then ship the trusses with blocking members having pre-attached clip members to the site where the trusses are raised on the roof, sheathing it applied to the trusses, and the blocking is attached to the trusses and the top portions of the wall creating a strong shear connection between the roof diaphragm and the top portions of the supporting walls.

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- The preferred embodiment of the clip of the present invention is formed with two indexing tabs that are set against the blocking. The clips are not pre-bent once attached to the blocking. Bending is easily done in the field. It is easier to stack and store the blocking with the pre-attached clips when the clips are
- 25 straight and therefore flat. It is also easier to install the blocking with the clips unbent.

It is an additional object of the present invention to provide the clip of the present invention with pre-formed openings for receiving fasteners that are used to attach the clip to the other elements of the connection.

- 30 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a preferred embodiment of the clip of the present invention.

FIG. 2A is a perspective view of a preferred embodiment of the connection of the present invention, with a double wood top plate and a gap between the  
5 double wood top plate and the blocking member, and the clip attached to the outer surface of the wall.

FIG. 2B is a perspective view of a preferred embodiment of the connection of the present invention, with a double wood top plate and no gap between the double wood top plate and the blocking member, and the clip attached to the  
10 outer surface of the wall.

FIG. 3A is a perspective view of a preferred embodiment of the connection of the present invention, with a masonry wall and a gap between the top portion of the masonry wall and the blocking member, and the clip attached to the outer surface of the wall.

15 FIG. 3B is a perspective view of a preferred embodiment of the connection of the present invention, with a masonry wall and no gap between the top portion of the masonry wall and the blocking member, and the clip attached to the outer surface of the wall.

FIG. 4A is a perspective view of a preferred embodiment of the connection of  
20 the present invention, with a double wood top plate and a gap between the double wood top plate and the blocking member, and the clip attached to the top surface of the wall.

FIG. 4B is a perspective view of a preferred embodiment of the connection of the present invention, with a double wood top plate and no gap between the  
25 double wood top plate and the blocking member, and the clip attached to the top surface of the wall.

FIG. 5A is a perspective view of a preferred embodiment of the connection of the present invention, with a masonry wall and a gap between the top portion of the masonry wall and the blocking member, and the clip attached to the top  
30 surface of the wall.

FIG. 5B is a perspective view of a preferred embodiment of the connection of the present invention, with a masonry wall and no gap between the top portion of the masonry wall and the blocking member, and the clip attached to the top surface of the wall.

5 FIG. 6 is a top down view of a preferred embodiment of the clip of the present invention.

FIG. 7 is a front elevation view of a preferred embodiment of the clip of the present invention.

FIG. 8 is a side elevation view of a preferred embodiment of the clip of the  
10 present invention.

FIG. 9 is a perspective view of a preferred embodiment of the connection of the present invention with a masonry wall.

FIG. 10 is a perspective view of a preferred embodiment of the connection of the present invention with a wood frame wall.

15 FIG. 11 is a perspective view of a preferred embodiment of the clip of the present invention having nail prongs.

FIG. 12A is a perspective view of a preferred embodiment of the connection of the present invention, with a double wood top plate and a gap between the double wood top plate and the blocking member, and the clip attached to the  
20 outer surface of the wall.

FIG. 12B is a perspective view of a preferred embodiment of the connection of the present invention, with a double wood top plate and no gap between the double wood top plate and the blocking member, and the clip attached to the outer surface of the wall.

25 FIG. 13A is a perspective view of a preferred embodiment of the connection of the present invention, with a masonry wall and a gap between the top portion of the masonry wall and the blocking member, and the clip attached to the outer surface of the wall.

FIG. 13B is a perspective view of a preferred embodiment of the connection of  
30 the present invention, with a masonry wall and no gap between the top portion

of the masonry wall and the blocking member, and the clip attached to the outer surface of the wall.

FIG. 14A is a perspective view of a preferred embodiment of the connection of the present invention, with a double wood top plate and a gap between the double wood top plate and the blocking member, and the clip attached to the top surface of the wall.

FIG. 14B is a perspective view of a preferred embodiment of the connection of the present invention, with a double wood top plate and no gap between the double wood top plate and the blocking member, and the clip attached to the top surface of the wall.

FIG. 15A is a perspective view of a preferred embodiment of the connection of the present invention, with a masonry wall and a gap between the top portion of the masonry wall and the blocking member, and the clip attached to the top surface of the wall.

FIG. 15B is a perspective view of a preferred embodiment of the connection of the present invention, with a masonry wall and no gap between the top portion of the masonry wall and the blocking member, and the clip attached to the top surface of the wall.

FIG. 16 is a top down view of a preferred embodiment of the clip of the present invention having nail prongs.

FIG. 17 is a front elevation view of a preferred embodiment of the clip of the present invention having nail prongs.

FIG. 18 is a side elevation view of a preferred embodiment of the clip of the present invention having nail prongs.

## DETAILED DESCRIPTION OF THE INVENTION

As best seen in Figs. 1, 6, 7 and 8, in its most preferred form, the clip 1 of the present invention is cut from 20-gauge galvanized sheet steel. Preferably, the clip 1 comprises a body 2 having an attachment side 3 and an opposing side 4, the body 2 being divided into a base portion 5 and a tab attachment portion 6 joined to the base portion 5. Preferably, the body 2 has first side edge 7 and a

second side edge **8**. Preferably, the first side edge **7** and the second side edge **8** each have a plurality of projections **9** that extend in the plane of the body **2**. Most preferably, the first side edge **7** has four projections **9** and the second side edge also has four projections **9**. Preferably, the body **2** is substantially

5 rectangular, with a first end edge **10** in the tab attachment portion **6** and a second end edge **11** in the base portion **5**. Preferably, the clip **1** has a plurality of fastener openings **12**. Most preferably, there are six fastener openings **12** in the tab attachment portion **6** and nine fastener openings **12** in the base portion **5**. Of the six fastener openings **12** in the tab attachment portion, three are in

10 the three projections **9** nearest the first end edge **10**. Of the nine fastener openings **12** in the base portion **5**, three are in the three projections **9** nearest the second end edge **11**. Of the six fastener openings in the base portion **5**, but not in the projections **9**, three are a different shape from the rest of the fastener openings **9** in the clip **1**. Preferably, these three fastener openings **9** are

15 hexagonal, whereas all the other fastener openings **9** are round. The three hexagonal fastener openings **9** indicate where to use, as a first plurality of fasteners **13** attaching the clip **1** to a wall **14** that is a masonry wall **14**, masonry screws **13**.

20 Preferably, the clip **1** has first indexing tab **15** projecting from the attachment side **3**. Most preferably, the clip **1** has a second indexing tab **16** projecting from the attachment side **3**. Most preferably, the first indexing tab **15** and the second indexing tab **16** are bent out of the tab attachment portion **6**. This first indexing tab **15** and the second indexing tab **16** allow the clip **1** to be rapidly

25 attached with the correct alignment and spacing to allow all of the necessary fasteners to be quickly and correctly installed.

Preferably, there is a score opening **17** generally in the middle of the body **2** between the first indexing tab **15** and the second indexing tab **16**, and all three

30 lie on a line that traverses the body **2** of the clip **1**, dividing the body **2** into the base portion **5** and the tab attachment portion **6**. Most preferably, a side of one

of the projections 9 on the first side edge 7, a side of one of the projections 9 on the second side edge 8, the first indexing tab 15, the second indexing tab 16 and the score opening 17 all line up to aid in bending the clip 1 when it is installed. Preferably, the clip 1 is bent to an angle that preferably allows the first blocking member 25 to match the slope of the adjacent roof trusses or rafters after the clip 1 is attached to both the blocking member 25 and the top portion 21 of the wall 14.

Preferably, the clip 1 additionally comprises reinforcing embossments 18 in the base portion 5 and the tab attachment portion 6. Most preferably, the reinforcing embossments 18 are linear and perpendicular to the first end edge 10 and the second end edge 11, with two in the base portion 5 and two in the attachment portion 6. Most preferably, the reinforcing embossments 18 in the base portion 5 are slightly shorter than the reinforcing embossments 18 in the attachment portion 6. The reinforcing embossments 18 reinforce the clip 1 against deformation when it is under load and confine installation bending to the middle of the clip 1.

As best seen in Figs. 2A and 2B, in a preferred embodiment, the roof boundary connection 19 comprises a wall 14 having a top portion 21, the top portion 21 having a top surface 22 and an outer surface 23. In a preferred embodiment, the wall 14 is a light wood frame wall, typically framed with nominal 2x4 lumber. Preferably, the top portion 21 is a wood top plate, most preferably a double top plate. As best seen in Figs. 3A and 3B, the wall 14 is a masonry wall, typically poured concrete or block. In this case, the top portion 21 is simply the top of the masonry wall. As best seen in Figs. 9 and 10, a plurality of generally horizontal structural members 24 surmount the wall 14 and are disposed generally perpendicular to the wall 14. The generally horizontal structural members 24 are preferably roof framing members, either roof trusses or rafters. These are typically made from lumber lighter than the nominal 2x4 framing used to construct the light wood frame wall 14. The roof trusses or



rafters span from one wall to another and support a roof diaphragm. The roof boundary connection 19 further comprises a first blocking member 25 having a bottom side 26, an inner side 27, an outer side 28, a first end 29 and a second end 30. The first end 29 and the second end 30 are each in substantially  
5 abutting relationship with one of the plurality of generally horizontal members 24. The first blocking member 25 is preferably made of wood, The first and second ends 29 and 30 of the first blocking member 25 are typically attached to the roof trusses or rafter by toenailing through the truss or rafter into the blocking member 25. A first clip 1 connects the first blocking member 25 to the  
10 top portion 21 of the wall 14. The clip 1 comprises a body 2 having an attachment side 3 and an opposing side 4, the body 2 being divided into a base portion 5 and a tab attachment portion 6 joined to the base portion 5. A first indexing tab 15 projects from the attachment side 3. The first indexing tab 15 interfaces with one of the top portion 21 of the wall 14 and the first blocking  
15 member 25. A first plurality of fasteners 13 attaches the clip 1 to the top portion 21 of the wall 14 and a second plurality of fasteners 31 attaches the clip 1 to the first blocking member 25. When the top portion 21 of the wall 14 is wood, the first plurality of fasteners 13 is preferably nails. When the blocking member 25 is wood, and the clip will be installed in the field, the second  
20 plurality of fasteners 31 is preferably nails.

Preferably, the clip 1 has a first indexing tab 15 and a second indexing tab 16 and both are placed so that they interface with the bottom side 26 of the first blocking member 25, thereby ensuring proper alignment of the clip 1 in relation  
25 to the first blocking member 25 and ensuring that enough of the tab attachment portion 6 interfaces with the first blocking member 25 and that all of the second plurality of fasteners 31 attach the clip 1 to the first blocking member 25. However, the first indexing tab 15, and the second indexing tab 16 if it is present, can interface with the top portion 21 of the wall 14 to perform the  
30 same function with respect to the wall 14.

As shown in Figs. 2A, 2B, 3A and 3B, the clip 1 can be installed so that there is little or no space between the first blocking member 25 and the top portion 21 of the wall 14. Or the clip 1 can be installed so that there is a gap between the first blocking member 25 and the top portion 21 of the wall 14. The amount of space between the first blocking member 25 and the top portion 21 of the wall 14 is preferably no more than  $\frac{3}{4}$  inches. The space allows the first blocking member 25 to be angled to match the pitch of the roof trusses or rafters, so that the first blocking member 25 will not interfere with the roof sheathing when it is applied, and to leave a gap for wall sheathing or even ventilation.

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As best seen in Fig. 11, 16, 17 and 18, in an alternate preferred embodiment, the second plurality of fasteners 31 is a plurality of nail prongs 31 extending from the attachment side 3 of the tab attachment portion 6 of the first clip 1, and the first and second indexing tabs 15 and 16 extend further from the attachment side 3 than the plurality of nail prongs 31. The nail prongs 31 differ from the first and second indexing tabs 15 and 16 in that they are sharper and are crimped for greater rigidity. The nail prongs 31 are primarily intended for pre-attachment of the clip 1 to blocking member 25 by truss manufacturers. The nail prongs 31 are driven by clamping the clip 1 between the first blocking member and a block or by using a hydraulic press. Nail prongs 31 allow truss manufacturers to install clips 1 on blocking members 25 with the same hydraulic presses that are used to assemble trusses with nail prong plates. The preferred embodiment of the clip 1 of the present invention is formed with first and second indexing tabs 15 and 16 that are set against the blocking member 25 so that the clip 1 can be installed rapidly in the correct manner, which is particularly important in a factory setting. The clips 1 attached to the precut blocking members 25 are preferably shipped unbent with the trusses 24. At the job site, the trusses 24 are set on the roof and spaced accordingly, and then the blocking 25 is attached to the trusses 24 and the tops of the walls 14 on which the trusses 24 are set. The blocking 25 is attached to the top portion 21 of the walls 14 by means of the clips 1. The portion of the clip 1 jutting out from the

blocking 25 - the base portion 5 -- is aligned with the top portion 21 of the wall 14, be it the side face or top surface 22 of the wall 14, so that the appropriate number of fasteners 13 for the wall 14 can be installed. This should result in, at the most, a gap of approximately  $\frac{3}{4}$  of inch between the top portion 21 of the wall 14 and the blocking 25. The first plurality of fasteners 13, appropriate for the wall 14 are driven through the proper openings 12 in the clip 1 and into the wall 14. The blocking 25 is then set at the proper angle for attachment to the trusses 24, which likely means that the clip 1 is bent at the interface between the base portion 5 and the tab attachment portion 6, and then fasteners, preferably nails, are driven through the blocking 25 at an angle and into the trusses 24.

The blocking 25 can be attached to the trusses 24 after the top sheathing has been applied to the trusses 24 or before. Because the clip 1 can be bent in the field and attached to the top surface 22 of the top portion 21 of the wall 14 or the side face of the top portion 21 of the wall 14, the installer has a choice as to where he can install the clip 1. Sometimes it will be difficult to attach the clip to the top surface 21 of the wall 14. Sometimes, the installer will prefer to attach the clip 1 to the top surface 21 of the wall 14, so the clip 1 is less likely to interfere with the sheathing of the outer surface 23 of the wall 14.

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As best seen in Figs. 2A through 5B and 12A through 15B, preferably the attachment side 3 of the base portion 5 interfaces with the top portion 21 of the wall 14. Preferably, the clip 1 is attached to either the top surface 22 of the wall 14 or the outer surface 23 of the wall 14, according to which is more easily accessible during installation. The attachment side 3 of the tab attachment portion 6 preferably interfaces with the inner side 27 of the first blocking member 25, but it can also interface with the outer side 28 of the blocking member. Typically, the attachment side 3 of the tab attachment portion 6 interfaces with the inner side 27 of the blocking member 25 when the attachment side 3 of the base portion 5 interfaces with the top surface 22 of the wall 14; the attachment side 3 of the tab attachment portion 6 interfaces

with the outer side 28 of the blocking member 25 when the attachment side 3 of the base portion 5 interfaces with the outer surface 23 of the wall 14.

The tab attachment portion 6 of the first clip 1 is preferably placed against the inner side 27 of the first blocking member 25 such that the first indexing tab 15 interfaces with the bottom side 26 of the first blocking member 25. The second plurality of fasteners 31 is driven into the inner side 27 of the first blocking member 25. The second plurality of fasteners 31 is preferably either nails or nail prongs. The base portion 5 of the first clip 1 is placed against the top portion 21 of the wall 14. The first plurality of fasteners 13 is driven into the top portion 21 of the wall 14, and the first clip 1 is bent along a line of juncture 32 between the base portion 5 and the tab attachment portion 6.

Alternatively, the tab attachment portion 6 of the first clip 1 is placed against the top portion 21 of the wall 14 such that the first indexing tab 15 interfaces with the top surface 22 of the wall 14. The first plurality of fasteners 13 is driven into the top portion 21 of the wall 14. The base portion 5 of the first clip 1 is placed against the outer side 28 of the first blocking member 25. The second plurality of fasteners 31 is driven into the outer side 28 of the first blocking member 25, and the first clip 1 is bent along a line of juncture 32 between the base portion 5 and the tab attachment portion 6.